IN-FLIGHT PERSONALIZED MEDICATION MANAGEMENT.

E. Peletskaya[1] and Y.V. Griko[2]

[1] *DiaCarta Inc. Richmond, CA, USA*

[2] *National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA 94035, USA*

Current medication selection for treatment of astronauts during spaceflight missions is primarily dictated by the task of efficiently treating the widest possible range of physiological conditions and illnesses with a limited set of medications. Dosage and recommendations on the combination of drugs are based on the assumption of genetically equal drug sensitivity and unchanged metabolism[1,2]. To our knowledge, there was no pre-flight drug sensitivity testing on a genetic level for any of the previous manned NASA space missions. Although many of the common, binary drug-drug interactions are, most likely, already considered in the ISS Medical kit composition, multi-drug and multi-drug-gene factors are not incorporated in the medication selection or prescription[1,2]. Furthermore, due to the physiological changes occurring in microgravity environments, astronauts might be susceptible to potential increased drug toxicity as a result of decreased clearance of numerous drugs. In particular, perturbation of CYP450 enzymes which contribute to the hepatic metabolism of the majority of drugs[3,4] may have significant effects on therapeutic efficacy and increase treatment-related toxicity[5]. The genes encoding the CYP450 enzymes are highly variable in humans. Inheritable variations of CYP450 hepatic metabolizer enzymes and transport proteins play a crucial role in the inter-individual variability of drug efficiency and risks of adverse drug reactions[5]. Additionally, there are some reports that document changes in the levels of production of drug-metabolizing enzymes in microgravity[5,6,7]. These data can be extrapolated to provide reasonable assumptions of decreased levels of expression for most CYP450 enzymes in human body during prolonged space travel. If the prescribed medication regiment is not fully effective or causes undesirable side effects, the ability of the astronauts to function and maintain peak performance levels during space flight could be seriously compromised. Therefore, technologies capable of predicting and managing medication side effects, interactions, and toxicity of drugs during spaceflight are needed.

We propose to develop and customize for NASA's applications available on the market Personalized Prescribing System (PPS) that would provide a comprehensive, non-invasive solution for safer, targeted medication management for every crew member resulting in safer and more effective treatment and, consequently, better performance. PPS will function as both decision support and record-keeping tool for flight surgeons and astronauts in applying the recommended medications for situations arising in flight. The information on individual drug sensitivity will translate into personalized risk assessment for adverse drug reactions and treatment failures for each drug from the medication kit as well as predefined outcome of any combination of them. Dosage recommendations will also be made individually. The mobile app will facilitate ease of use by crew and medical professionals during training and flight missions.

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